

CLAIMS

What is claimed is:

1. A molded thermoplastic article comprising a fibrous material embedded in a thermoplastic resin matrix, the article prepared by a low shear process comprising the steps of:

a) melt compounding a mixture of a thermoplastic resin, the fibrous material, and any optional additives using a low shear single screw, wherein the lengths of the fibers of the fibrous material before molding are about 0.5-3 inches long, and the fibrous material comprises 5-55% of the total weight of the compounded mixture;

b) extruding the mixture through a sheet extrusion die using low shear extrusion;

c) depositing the extruded mixture into a first half of a horizontally-movable matched mold in approximately the general shape of the article; and

d) compression molding the deposited mixture with the second half of the matched mold such that pressures in the range of 100-1,000 psi and substantially little movement of the molten mixture are required to complete consolidation and molding of the thermoplastic article,

wherein:

the lengths of the fibers of the fibrous material in the molded article are greater than about 60% of their pre-molded lengths;

less than about 20% of the fibers of the fibrous material in the molded thermoplastic article are oriented in the same direction; and

the mechanical properties of the molded article in the x-, y-, and z-planes are within 20% of each other.

2. The article according to claim 1, wherein the process is conducted substantially under low shear conditions.

3. The article according to claim 1, wherein the extrusion is conducted through a multi-gated, horizontally mounted sheet extrusion die with independently controlled gates capable of varying the thickness of the mixture extruded through each gate.

4. The article according to claim 1, wherein the resin/fibrous material mixture is gravity-deposited in the mold in step c) in a molten net near shape laydown of the molded article.

5. The article according to claim 1, further comprising transferring the resin/fibrous material mixture through a transfer pipe prior to extrusion.
6. The article according to claim 1, wherein the fibrous material is selected from the group consisting of glass fibers, fiberglass, carbon fibers, synthetic fibers, metal fibers, natural fibers, cellulose, and wood.
7. The article according to claim 1, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyhaloolefins, polyaromatics, poly(alkenylaromatics), polystyrene, acrylonitrile/butadiene/styrene resins, polyamides, nylon, poly(carboxylic acids), polyamines, polyethers, polyacetals, polysulfones, poly(organoicsulfides), poly(organoicoxides), polyesters, polycarbonates, polyimides, polyurethanes, polyetheretherketone resins, styrene/maleic anhydride resins, and mixtures thereof.
8. The article according to claim 1, wherein the thermoplastic resin is a homopolymer, copolymer, random copolymer, alternating copolymer, block copolymer, graft copolymer, liquid crystal polymer, or mixtures thereof.
9. The article according to claim 1, wherein the thermoplastic resin is a virgin resin, a recycled resin, or a mixture thereof.
10. The article according to claim 1, wherein the extrusion is conducted at a temperature in the range of 300-700°F.
11. The article according to claim 1, wherein the optional additive is a coupling agent which enhances bonding of the fibrous material to the thermoplastic resin.
12. The article according to claim 1, wherein the mold is a metallic mold, non-metallic mold, ceramic mold, or a wooden mold.
13. The article according to claim 1, wherein the tensile strength, tensile modulus, and flexural strength of the article in the axial and transverse directions are within 20% of each other.
14. The article according to claim 1, wherein the lengths of the fibers of the fibrous material in the molded article are greater than about 70% of their pre-molded lengths.

15. The article according to claim 1, wherein the lengths of the fibers of the fibrous material in the molded article are greater than about 80% of their pre-molded lengths.
16. The article according to claim 1, wherein the lengths of the fibers of the fibrous material in the molded article are greater than about 90% of their pre-molded lengths.
17. The article according to claim 1, wherein the mechanical properties of the article are substantially anisotropic.
18. The article according to claim 1, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 0.5 feet.
19. The article according to claim 1, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 1.0 feet.
20. The article according to claim 1, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 2.0 feet.
21. The article according to claim 1, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 3.0 feet.
22. The article according to claim 1, wherein the weight of the article is greater than about 10 lbs.
23. The article according to claim 1, wherein the weight of the article is greater than about 20 lbs.
24. The article according to claim 1, wherein the weight of the article is greater than about 25 lbs.
25. The article according to claim 1, wherein the process is an insert molding process.
26. A molded thermoplastic article comprising a fibrous material embedded in a thermoplastic resin matrix, wherein:
 - the lengths of the fibers of the fibrous material before molding are about 0.5-3 inches long, and the fibrous material comprises 5-55% of the total weight of the compounded mixture;
 - the lengths of the fibers of the fibrous material in the molded article are greater than

about 60% of their pre-molded lengths;

less than about 20% of the fibers of the fibrous material in the molded thermoplastic article are oriented in the same direction; and

the mechanical properties of the molded article in the x-, y-, and z-planes are within 20% of each other.

27. The article according to claim 26, wherein the fibrous material is selected from the group consisting of glass fibers, fiberglass, carbon fibers, synthetic fibers, metal fibers, natural fibers, cellulose, and wood.

28. The article according to claim 26, wherein the thermoplastic resin is selected from the group consisting of polyolefins, polyhaloolefins, polyaromatics, poly(alkenylaromatics), polystyrene, acrylonitrile/butadiene/styrene resins, polyamides, nylon, poly(carboxylic acids), polyamines, polyethers, polyacetals, polysulfones, poly(organicsulfides), poly(organicoxides), polyesters, polycarbonates, polyimides, polyurethanes, polyetheretherketone resins, styrene/maleic anhydride resins, and mixtures thereof.

29. The article according to claim 26, wherein the thermoplastic resin is a homopolymer, copolymer, random copolymer, alternating copolymer, block copolymer, graft copolymer, liquid crystal polymer, or mixtures thereof.

30. The article according to claim 26, wherein the thermoplastic resin is a virgin resin, a recycled resin, or a mixture thereof.

31. The article according to claim 26, wherein the resin comprises a coupling agent which enhances bonding of the fibrous material to the thermoplastic resin.

32. The article according to claim 26, wherein the tensile strength, tensile modulus, and flexural strength of the article in the axial and transverse directions are within 20% of each other.

33. The article according to claim 26, wherein the lengths of the fibers of the fibrous material in the molded article are greater than about 70% of their pre-molded lengths.

34. The article according to claim 26, wherein the lengths of the fibers of the fibrous material in the molded article are greater than about 80% of their pre-molded lengths.

35. The article according to claim 26, wherein the lengths of the fibers of the fibrous material in the molded article are greater than about 90% of their pre-molded lengths.
36. The article according to claim 26, wherein the mechanical properties of the article are substantially anisotropic.
37. The article according to claim 26, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 0.5 feet.
38. The article according to claim 26, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 1.0 feet.
39. The article according to claim 26, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 2.0 feet.
40. The article according to claim 26, wherein the length of the article in at least one of the x-, y-, and z-planes is greater than about 3.0 feet.
41. The article according to claim 26, wherein the weight of the article is greater than about 10 lbs.
42. The article according to claim 26, wherein the weight of the article is greater than about 20 lbs.
43. The article according to claim 26, wherein the weight of the article is greater than about 25 lbs.
44. The article according to claim 26, further comprising one or more optional reinforcing inserts.
45. The article according to claim 44, wherein the reinforcing inserts are selected from the group consisting of tubes, rods, mesh, and combinations thereof.
46. The article according to claim 26, wherein the article has one or more solid raised three-dimensional features.
47. The article according to claim 46, wherein the one or more solid raised three-dimensional features are blind ribs, posts, mounting posts, or tabs.